SYSTEM AND METHOD FOR MONITORING CONGESTION PAGING

BACKGROUND OF THE INVENTION

Field of Invention

5   The present invention relates generally to mobile communications and, more particularly, to a system and method for monitoring paging signals transmitted from a mobile switch to a cell site for occurrences of congestion.

Description of the Background

   As mobile telephones have grown from mere voice communications devices to

10 sophisticated appliances for paging, text functions and Internet access, bandwidth management has become a critical function for providing Quality of Service (QoS). A wireless communications network typically includes a mobile switch, a paging area, and a cellular device such as a cellular telephone. The mobile switch manages traffic between cellular users. The paging area includes a plurality of cellular telephone transmitters, or cell sites, that cover a

15 certain geographical area. In operation, the mobile switch directs a page, addressed to a certain cellular device, to the appropriate paging area. A cell site, within the paging area, then broadcasts the page, causing, for example, a cellular phone to ring. In practice, network congestion occurs between the mobile switch and a cell site, due in part to limited bandwidth between the switch and the cell site. Such congestion may cause pages sent from the switch to a

20 targeted cellular device, via the cell site, to be lost. Lost pages cause users of cellular devices, such as cellular phones, to miss calls because the phone fails to ring. Paging congestion, therefore, significantly affects QoS. Additionally, paging congestion can lead to substantial revenue losses for telecommunications service providers that fail to collect for unconnected calls.

A mobile switch may communicate with a cell site over a T-1 line. A T-1 line is a commonly used digital line that bundles 24 channels called DS0s, where each DS0 is capable of transmitting 64 kbps, for an overall transmission rate of 1.5 Mbps. Some wireless communication networks, however, may limit paging communications to just one of the 24

5   channels in a T-1 line, reserving the other 23 channels for transmitting voice data. The growing popularity of cellular phones has caused the DS0 channel dedicated to paging to operate at or beyond its 64 kbps capacity. New services, such as short messaging service and message waiting indicators on cellular phones, also share the same DS0.

A network diagnostic tool is needed that enables service providers to identify, and even

10   quantify, instances of paging congestion. Such a system needs to provide sufficient flexibility to identify paging congestion problems that exceed certain quantitative thresholds. Such a system also needs to provide a notification system in which certain network operators receive timely alerts when a paging congestion problem occurs. The present invention satisfies this need.

SUMMARY OF THE INVENTION

15   The present invention is directed to systems and methods for monitoring a paging signal from a mobile switch to a cellular transmitter for occurrences of congestion. According to one embodiment, the system comprises a switch; a cell site in communication with the switch, for broadcasting a page received from the switch to a cellular device configured to receive the page; and a monitoring module in communication with the switch for monitoring occurrences of

20   paging congestion between the switch and the cell site.

The present invention may be used, for example, to monitor pages transmitted from the mobile switch but not received by the cell site. In the case of a cellular phone, pages transmitted from the mobile switch cause the receiving cellular phone to ring. Lost pages, however, cause

2

customers to miss calls. The present invention may be used, for example, as a statistical tool for identifying operational problems that might otherwise go unnoticed. In addition to statistical benefits, the present invention may also be used to notify network operators of paging congestions problems. Finally, the present invention may also be used as a loss of revenue

5   indicator by quantifying the number of lost pages that resulted in, for example, unconnected calls.

These and other benefits of the present invention will be apparent from the detailed description below.

DESCRIPTION OF THE FIGURES

10   For the present invention to be understood clearly and readily practiced, the present invention will be described in conjunction with the following figure, wherein:

FIG. 1 is a block diagram of a cellular communications system according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

15   It is to be understood that the figures and descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention while eliminating, for purposes of clarity, other elements. For example, certain system details and modules of certain intelligent platforms are not described herein. Those of ordinary skill in the art will recognize, however, that these and other elements may be desirable in a

20   typical network. A discussion of such elements is not provided because such elements are well known in the art and because they do not facilitate a better understanding of the present invention.

FIG. 1 is a block diagram of a cellular communications system 10 according to one

embodiment of the present invention for monitoring paging congestion between a mobile switch

and a cell site. The system 10 includes a page-monitoring module 12, a mobile switch 14, a

public switched telephone network (PSTN) 16, a cell site 18, and a cellular device 20. The

5 monitoring module 12, as described further hereinbelow, receives reports of missed pages from

the mobile switch 14 and outputs a notification 22 to network operators 24, such as by email or

page, when the number of missed pages due to paging congestion exceeds a predetermined

amount. The mobile switch 14 is the bridge between the PSTN 16 and the cell site 18 that

ultimately makes the wireless connection to the user's cellular device 20.

10 The monitoring module 12, which communicates with the paging queue of mobile switch

14, may be implemented on an intelligent platform such as, for example, a computer, such as a

workstation or a personal computer, a microprocessor, a network server, or an application

specific integrated circuit, using any suitable type of computer instruction. Module 12 may also

be implemented as software code to be executed by the system 10 using any suitable computer

15 language such as, for example, microcode, and may be stored in, for example, an electrically

erasable programmable read only memory (EEPROM), or can be configured into the logic of the

system 10. According to another embodiment, module 12 may be implemented as software code

to be executed by the system 10 using any suitable computer language such as, for example,

Java, Perl, C or C++ using, for example, conventional or object-oriented techniques. The

20 software code may be stored as a series of instructions or commands on a computer readable

medium, such as random access memory (RAM), read only memory (ROM), a magnetic medium

such as a hard-drive or a floppy disk, or an optical medium such as CD-ROM. According to one

embodiment, module 12 may be integrated with the hardware or software of the mobile

switch 14.

According to one embodiment, the mobile switch 14 may be in communication with the

module 12, the PSTN 16, and the cell site 18 via a communications network 25 including,

5   individually or in combination, a wireline network or a wireless network. The communications

network may include, for example, individually or in combination, a plain old telephone system

(POTS), a public switched telephone network (PSTN), a wireless telephone network, the

Internet, an intranet, a LAN, or a WAN, using, for example, packet-switching or circuit

switching transmission modes. According to another embodiment, the mobile switch 14 may be

10   part of a mobile switching center (MSC) in communication with the module 12 and the cell

site 16.

According to one embodiment, the monitoring module 12 is configured to count the

number of occurrences of paging congestion between the mobile switch 14 and the cell site 18.

An occurrence of paging congestion refers to an instance where, for example, a cellular phone

15   customer did not receive notification of an incoming call. For example, when the mobile

switch 14 receives an incoming call directed to the cellular device 20, the mobile switch 14

issues a page 26 to the cellular device 20 via the cell site 18. Normally, when the cellular

device 20 receives the page 26, the cellular device 20 rings, notifying the cellular subscriber of

an incoming call. During instances of paging congestion between the mobile switch 14 and the

20   cell site 18, however, the page 26 may be lost. According to such an embodiment, module 12

may count the lost pages over a predetermined time interval.

According to another embodiment, module 12 may use the lost page information to

perform some corrective action. For example, module 12 may notify network operators 24 when

the number of lost pages reaches a predetermined limit, such as 100 lost pages in one hour.

According to such an embodiment, module 12 may issue notification 22 to the network

operators 24, such as by electronic mail or by page, via, for example, a wide area network

(WAN) 28. The notification 22 may include, for example, the number of pages lost over some

5   time interval. Notifications may also include information to facilitate troubleshooting, such as

the location of paging congestion. The location may be designated by, for example, paging area.

It should be understood that the invention is not limited by the foregoing description of

preferred embodiments, but embraces all such alterations, modifications, and variations in

accordance with the spirit and scope of the appended claims.

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